An Integrated Assessment of the Impacts of Air Pollution on Health in Eastern China: A valuation with implications for future air pollution and energy policies

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Our objective is to establish the link between energy consumption and technologies, air pollution, resulting impacts on public health and the monetary value of those impacts in order to provide justification for expenditures on energy technology to reduce health impacts in eastern China. We use Zaozhuang, a city in eastern China heavily dependent on coal, as a case study to quantify the impacts that air pollution in eastern China had on public health in 2000 and the benefits in improved air quality and health that could be obtained by 2020, relative to business-as-usual (BAU), through the implementation of best available end-of-pipe environmental controls (BACT) and advanced coal gasification technologies (ACGT). The BACT scenario provides an opportunity to reduce reactive air pollutant emissions while the ACGT scenario provides the opportunity to reduce both reactive air pollutant emissions and to sequester carbon dioxide while continuing to use high sulfur coal. We use an integrated assessment approach, incorporating the state of knowledge of air quality and meteorological models, engineering, epidemiology, and economics, to achieve our objective.

We first develop a highly-resolved emission inventory for the year 2000 for the Shandong region of China including emissions from large point, area, mobile and biogenic sources. We use the Sparse Matrix Operator Kernel Emissions Modeling System (SMOKE) to process emissions from this inventory for use in the Community Multi-scale Air Quality modeling system (CMAQ) which we drive with the NCAR/PSU MM5 meso-scale meteorology model. We evaluate the inventory by comparing CMAQ results with available measurements of PM10 and SO_2 from air pollution indices (APIs) reported in various Chinese municipalities during 2002-2004. We use epidemiological dose-response functions to quantify health impacts and values of a statistical life (VSL) and years-of-life-lost (YLL) to establish a range for the monetary value of these impacts for each scenario. In all scenarios health damages arise primarily from exposure to particulate matter.

We find that total health damages due to year 2000 anthropogenic emissions from Zaozhuang accounted for 5-10% of GDP. If all health damages resulting from coal use were internalized in the market price of coal, the year 2000 price would have doubled. With no new air pollution controls implemented between 2000 and 2020 but with expected increases in energy use, we estimate health damages from air pollution exposure to account for 9-16% of Zaozhuang's projected 2020 GDP. BACT could reduce the potential health damage of air pollution by 20% relative to BAU and ACGT could reduce

it by 50% relative to BAU with only 24% market penetration. Benefits to public health, of substantial monetary value, could be achieved in eastern China through the use of BACT; health benefits from the use of ACGT could be even larger while simultaneously permitting sequestration of carbon dioxide.